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ABSTRACT

COMPENSTAT, a menu-driven statistical program for IBM-compatible microcomputers, has two distinct versions: instructional and computational. The instructional version can be used by instructors as a classroom resource, and the computational version is used directly by students to calculate answers to problems. The software package is primarily used as an assignment generating and problem solving tool. Each student in a class is assigned unique data for a problem type. Since all data sets generate different answers, students can help each other learn but cannot simply copy answers. The instructor is not burdened with extra work, since each student's assignment is followed by a personalized answer key on which the student's answer is computed. An answer sheet is even provided to organize students' responses for easy checking. This paper provides instructions for using the menu-driven features of COMPENSTAT in a business statistics course including diagrams of the menu options, which facilitate building, viewing, or modifying data sets; generating individualized assignments for students in a class; and performing statistical calculations (e.g., frequency distributions, descriptive statistics, probability distributions, confidence intervals, hypothesis testing, chi-square and ANOVA, index numbers, regression and correlation, and nonparametric statistics). Examples of a COMPENSTAT answer sheet and statistical problems on regression, correlation, and ANOVA are also provided. (GL)

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CAI and CMI Methods for Teaching Business Statistics Using COMPENSTAT

by William V. Sanders

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COMPENSTAT is actually comprised of two distinct versions: instructional and computational. The instructional version can be included in the class of programs known as "Computer-Managed Instruction" (CMI), since it is used by instructors as a classroom resource. The computational version is "Computer-Aided Instruction" (CAI), since it is used directly by students to calculate answers to problems.

Both versions have the same general structure. They are "packages" of menu-driven statistical programs. Both are available for MS/DOS (IBM-compatable) machines through Science Research Associates (now part of Macmillan), and are also used on DEC VAX equipment. No particular configurations of computer are required, except for a BASIC and a printer for the instructor.

What COMPENSTAT Does

COMPENSTAT is an assignment generating (and solving) tool. Each student in a class is assigned unique data for a common statement problem. The student's name appears on the assignment along with the question and data. Since all data sets generate different answers, students can help each other learn, but cannot simply copy answers. The instructor is not burdened with extra work, since each student's assignment is followed by a personalized answer key on which the student's answer is computed. An answer sheet is even provided to organize students' responses for easy checking.

In the usual course of events, the MS/DOS version requires the instructor to enter the class role into the "Roster Maker" each semester. To generate a copy of the assignment for class members, the instructor simply chooses the assignment from a menu, waits until the assignments and keys print, and bursts the paper. Assignments are given out in class. Students use the computational version of COMPENSTAT or a more powerful statistical package (e.g., SAS or TSP) to perform the indicated calculations, then answer the question posed in the space provided on the answer sheet. The instructor collects the answer sheets, compares them to keys, staples the two together (comments are unecessary) and returns the evaluated answer to the student. Evaluation of COMPENSTAT assignments is as fast as that for standard end-of-chapter problems.

The VAX (main computer) version is even easier, since the student roster is created with a single keystroke, assignments are automatically distributed through electronic mail, and (faster) line printers can be used to print assignment keys. A teaching assistant can do the rest.

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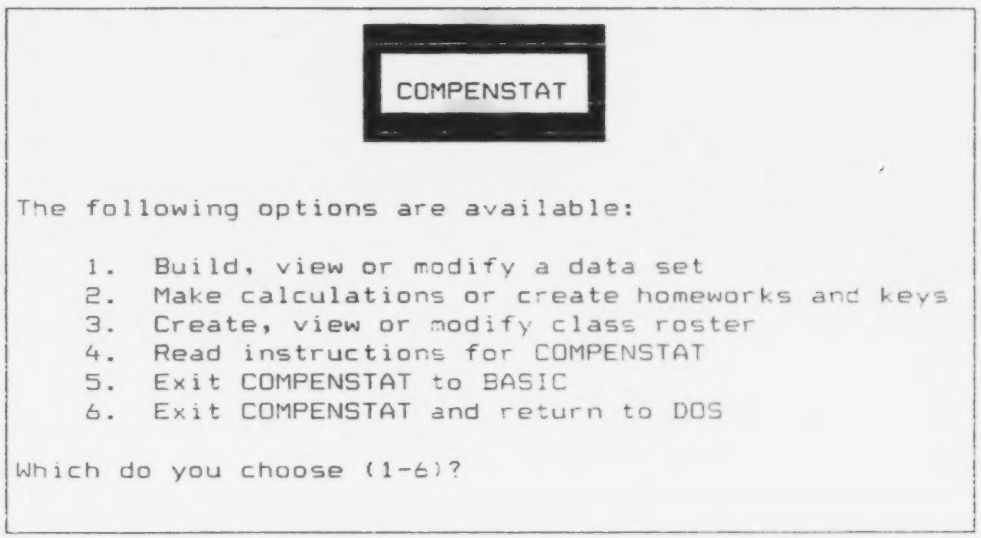
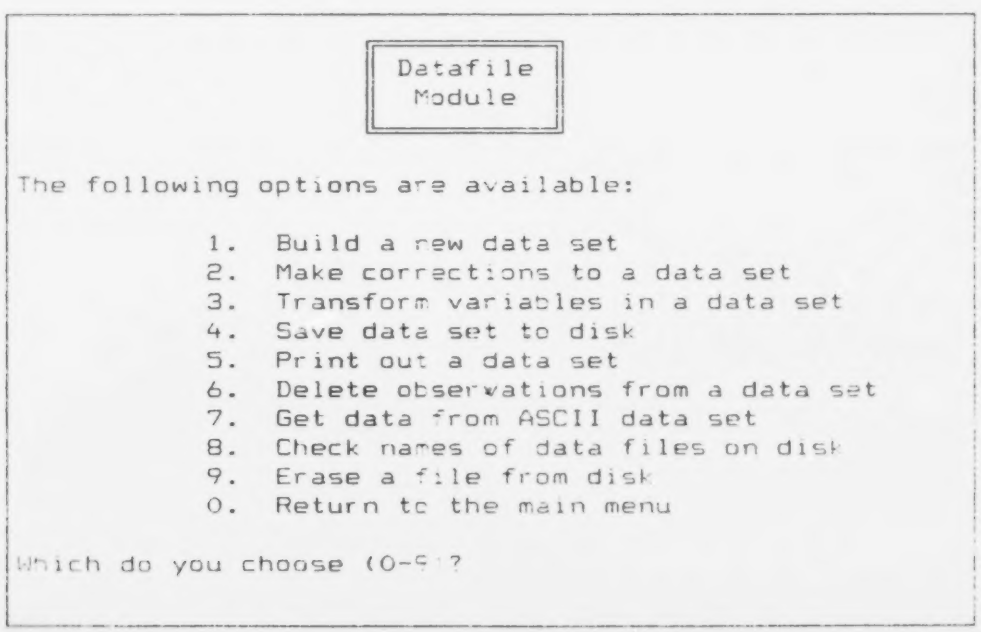
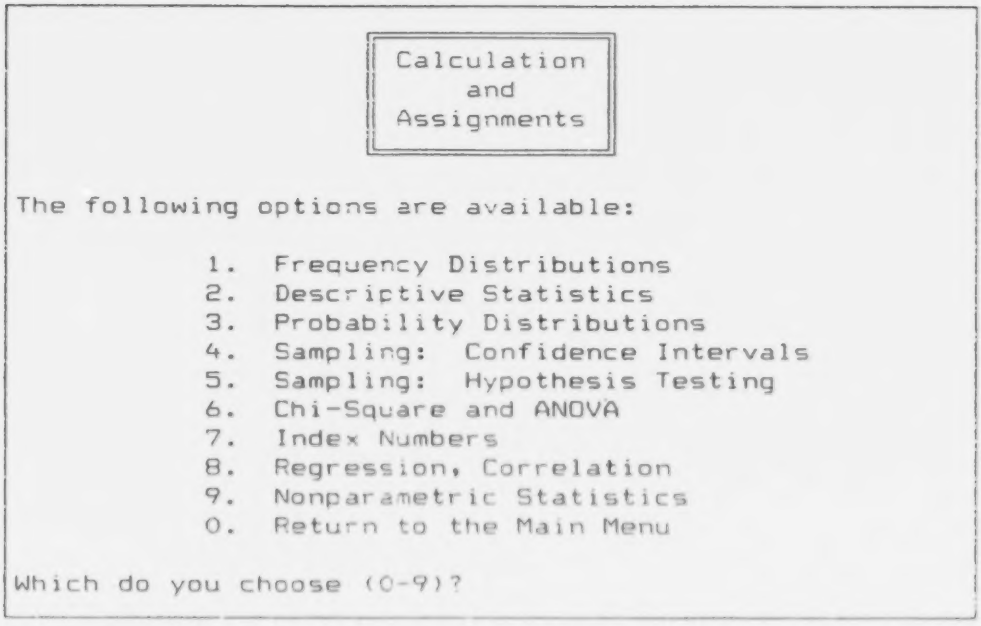
How to Use COMPENSTAT

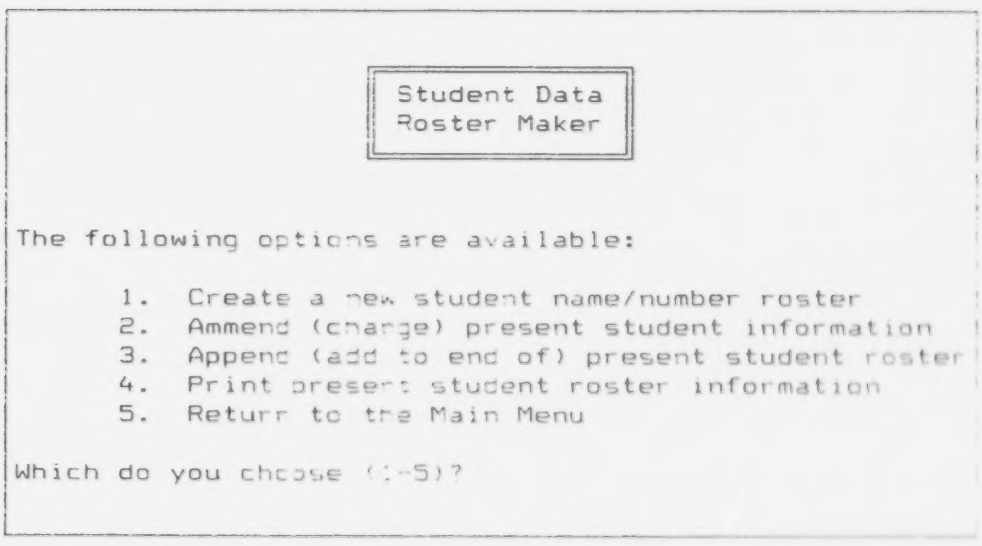
Once installed, COMPENSTAT comes up automatically when the computer is powered up. If it is on a floppy disk, for example, simply put the disk in Drive A and flip the power switch. After the banner page, the instructor's version presents the following main menu:


COMPENSTAT
The following options are available:
1. Build, view or modify a data set
2. Make calculations or create homeworks and keys
3. Create, view or modify class roster
4. Read instructions for COMPENSTAT
5. Exit COMPENSTAT to BASIC
6. Exit COMPENSTAT and return to DOS
Which do you choose (1-6)?

Note that the instructor's version also has the ability to use data and calculate answers, which can be handy for checking exam and end-of-chapter answers given in instructor's manuals. Choices 1-3 send the user to one of the following secondary menus:


Datafile Module
The following options are available:
1. Build a new data set
2. Make corrections to a data set
3. Transform variables in a data set
4. Save data set to disk
5. Print out a data set
6. Delete observations from a data set
7. Get data from ASCII data set
8. Check names of data files on disk
9. Erase a file from disk
0. Return to the main menu
Which do you choose (0-9)?




Student Data
Roster Maker
The following options are available:
1. Create a new student name/number roster
2. Ammend (change) present student information
3. Append (add to end of) present student roster
4. Print present student roster information
5. Return to the Main Menu
Which do you choose (1-5)?

Of course, the student version does not have the main menu, the roster module or the capacity to generate assignments. The calculation menu, which is set up along the lines of typical business and economics statistics texts, includes options for viewing instructions or transferring to the database module.

All nine options on the Calculation and Assignments Menu lead to tertiary menus that give further options. For example, if the instructor chooses 3 at the Main Menu and 8 at the

Calculation and Assignments Menu, the following tertiary menu would appear:

```
                Regression and Correlation
                Assignments & Calculations

The following options are available:

          1.  Simple Linear Regression Data
          2.  Curvilinear Regression Data
          3.  Multiple Regression Data
          4.  Return to the Calculator Menu

Which do you choose (1-4)?
```

For a class of two students (or two selected from a larger group), a choice of 3 from this menu brings the five pages given in the appendix: an answer sheet that may be photocopied to keep student answers in a uniform order; two data sets for the two class members (Bacon and Bitner); and two answer keys (also for students Bacon and Bitner).

Classroom Performance

The creation of a business statistics assignment requires six keystrokes by the instructor, using the instructional (CMI) version of the package. Since the package is menu-driven, very little "startup" time is needed. Evaluation of answers reduces to a comparison of keys and (neat, orderly) answer sheets, and a glance at the written conclusions. Written comments are replaced by the key sheets, saving time. The computer-generated keys answer many questions before they are asked. Three sections of forty students (120 total) can be carefully evaluated in two hours.

Computer assignments should not be left until a major multiple regression project, since the computation, statistical technique and interpretation are confusing when dumped on a student at one time. If assignments are used throughout, however, students like computer-related (CAI) problems. Students will help each other with concept and computer-related problems. Best of all, the learning of concept and application seems to be promoted by the use of these clear, short problems.

Overall performance can be illustrated by the anecdotal evidence of my own classroom experience. My Ec & Bus Stat II classes usually begin with 45 students/section. Two-three sections may be assigned per instructor, plus other courses to complete the four-section load. Computer-related projects were nightmares of confusion and paperwork. As usual in such cases, only one or two assignments were given per term. A line of ten students commonly greeted me upon return to my office. The frustration level was high for all involved.

After developing COMPENSTAT, all this changed. Now, six assignments and a term project are the norm. Students stay away from my door in droves and think the assignments are straightforward, despite the fact that they now do more work than their instructor. The competence shown by the assignment answers is much higher and, if exam scores are an indication, students understand the statistics and ec/bus applications better. In short, the computer exercise changed from a largely pointless, mechanical headache to a real vehicle for education.

A colleague has developed some assignment-generating modules for an MBA-level class that work much the same way as COMPENSTAT modules, and has had similar success. From these and other experiences that have come to my attention, my conclusion is that assignment generators are valuable in turning large classes into true learning experiences.

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Waxman's Furniture Answer Sheet Name_____

Estimated Equation:

Student t Statistics:

Hypothisis Tests:

Ho

Ha:

_____

_____

Decision Rule:

Test Statistic:
Decision:

Implications:

Ho

Ha:

_____

_____

Decision Rule:

Test Statistic:

Decision:

Implications:

Ho

Ha:

_____

_____

Decision Rule:

Test Statistic:

Decision:

Implications:

Student Bacon Waxman's Furniture Problem

Instructions:

Use the following data on the quantity demanded of widgets (QW), widget prices (P), and income level (Y)to determine an estimate of the generalized demand equation for widgets atWaxman's Furniture

QW	P	Y
4962	34.15	9992.93
2929	6.61	5873.31
1498	46.74	3092.07
2263	44.75	4618.58
1831	41.3	3744.47
1780	27.48	3614.87
3511	43.64	7111.25
3805	30.01	7671.73
4090	27.23	8236.361
948	26.39	1950.29
946	18.45	1929.37
586	43.02	1260.14
1576	41.34	3234.23
436	3.93	879.5899
3635	21.14	7312.07
2775	34.36	5618.22
4454	33.06	8972.46
193	8.93	402.77
1626	2.32	3259.35
251	3.45	511.57
2604	3.56	5216.67
276	42.56	637
4932	11.4	9888.389
2969	.88	5940.2
1098	1.65	2201.24
728	4.23	1465.1
3491	48.96	7082
1043	26.64	2138.48
4818	27.94	9691.79
1398	43.94	2887.08

Student: Bacon Waxman's Furniture Problem

The true (population) equation is:

QD = 9.999999E-02 - 1.0P + .5Y

The estimated (sample) equation is:

Y-hat =-.470459 +-1.002185 X1 + .5000075 X2

Summary Statistics:

	Y	X1	X2
Sum	67452	750.0601	136433.6
Mean	2248.4	25.002	4547.786
Sum Squares	6.74424E+07	7874.481	2.707297E+08
Std. Dev.	1524.991	16.47828	3055.406
Variance	2325598	271.5338	9335507

Correlation Matrix:

	Y	X1	X2
Y	1.00	.160304	.9999449
X1	.160304	1.00	.1708267
X2	.9999449	.1708267	1.00

Regression, Correlation Statistics:

R-squared = .9999998

Adjusted R2 = .9999998

F statistic = 6.907715E+07 5.662309E+07

s of b1 = 1.765653E-02 t of b1 =-56.76003

t1 is unreliable due to the possibility of rounding errors!

s of b2 = 9.684594E-05 t of b2 = 5162.916

t2 is unreliable due to the possibility of rounding errors!

ANOVA Table

Source of Variation	Degrees Freedom	Sum of Squares	Mean Squares	Test Statistic
Model	2	6.744238E+07	3.372119E+07	6.907715E+07
Error	27	13.18051	.488167	
Total	29	6.74424E+07		

Student Bitner Waxman's Furniture Problem

Instructions:

Use the following data on the quantity demanded of widgets (QW), widget prices (P), and income level (Y)to determine an estimate of the generalized demand equation for widgets atWaxman's Furniture

QW	P	Y
3256	7.52	
3256	7.52	6527.82
3631	22.01	7305.8
1368	27.55	2792.98
1948	3.21	3905.51
503	26.74	1061.48
2532	26.32	5118.42
3187	30	6435.84
2890	15.67	5812.68
1880	11.68	3784.23
440	46.21	973.65
4057	47.29	8209.19
2867	43.42	5821.05
2276	12.35	4578.88
2520	31.67	5105.85
3967	30.61	7995.84
1927	37.05	3930.61
1694	28.16	3445.43
3607	33.3	7280.66
2985	29.35	6030.17
24	45.96	141.36
240	9.689999	501.06
3757	49.93	7615.26
994	44.11	2077.81
2265	20.74	4570.5
2866	6.95	5745.78
3021	32.13	6109.64
3161	24.31	6373.13
3538	10.8	7100.84
4453	19.94	8945.22
1291	30.5	2646.63

Student: Bitner Waxman's Furniture Problem

The true (population) equation is:

QD = -.11 - 1.0P + .5Y

The estimated (sample) equation is:

Y-hat =-1.151123 +-.9979423 X1 + .500077 X2

Summary Statistics:

	Y	X1	X2
Sum	73145	805.17	147943.3
Mean	2438.167	26.839	4931.445
Sum Squares	4.210061E+07	5066.741	1.680757E+08
Std. Dev.	1204.883	13.21799	2407.429
Variance	1451743	174.7151	5795713

Correlation Matrix:

	Y	X1	X2
Y	1.00	-.0800295	.9999398
X1	-.0800295	1.00	-6.913816E-02
X2	.9999398	-6.913816E-02	1.00

Regression, Correlation Statistics:

R-squared = .9999998
Adjusted R2 = .9999998
F statistic = 6.222482E+07 7.549746E+07
s of b1 = 7.829121E-03 t of b1 =-127.4655
t1 is unreliable due to the possibility of rounding errors!
s of b2 = 4.28065E-05 t of b2 = 11682.27
t2 is unreliable due to the possibility of rounding errors!

ANOVA Table

Source of Variation	Degrees Freedom	Sum of Squares	Mean Squares	Test Statistic
Model	2	4.21006E+07	2.10503E+07	6.222482E+07
Error	27	9.133946	.3382943	
Total	29	4.210061E+07		